Machinery MESsage

No Singular Piece of Data Can Reveal Problem

*In the winter issue of **Orbit**, we presented the case history of a high speed gear pinion and its coupled centrifugal compressor rotor. After some operating time in the field, it was determined that the pinion first balance resonance was too close (above) the maximum operating speed. The pinion shaft was shortened to raise the critical speed. After this modification, test run data was presented for probes at the inboard bearings of the gear pinion and compressor rotors. The Bode plots showed very smooth operation, with amplitudes of one mil or less, even through the compressor first critical at approximately 4700 rpm. However, as the machine approached maximum rated speed, some amplitude increase was seen on both channels.*

*It was thought at first that the pinion critical was not increased as much as calculations indicated and the rotor responded, albeit slightly, to it. However, it was possible, with the absence of the pinion first critical, that the machine was showing a small response to the **second** balance resonance of the **compressor** rotor. We put forth the question: "What data is necessary to confirm either of these theories?"*

And now for our answer.

Phase angle measurements at each of the four bearings would show the response to be either pinion first critical (each end of pinion in-phase) or compressor second critical (each end of compressor out-of-phase).

Figures 1 and 2 show the most graphic display available of phase angle data—oscilloscope orbits. Obviously, the rotor response is not caused by the approach of the compressor second balance resonance because each end of the compressor is in-phase.

The moral of the story: Look at all the data which can be reasonably acquired. No singular data presentation can reveal everything about a given machine.

Rotor balancing is another example of the need to look at all available data. Too often, the only data considered in a balancing program is the vibration amplitude and phase angle at the balancing speed.

The VF-M allows the observation of machine response data from zero speed up to balancing speed. This data may not seem important when balancing rigid rotors operating below the first critical, but it is essential for effective high speed or in-place balancing at speeds above one or more resonances.

In attempting to balance a rotor, it is not sufficient to decrease vibration levels only at balancing or operating speeds. It is also necessary to observe the rotor response, especially in resonant speed regions, while the machine comes up to speed. When data is acquired at several locations along the rotor, this amplitude and phase response information can define the location of critical speeds, reveal the machine's synchronous amplification factor, and determine shaft mode shapes.

In the next issue, we'll discuss in-place balancing considerations and the data required for a successful effort. Specifically, we'll present some unique requirements for a specific machine type—the turbine generator. Large turbogenerators in particular present as much of a challenge for balancing as any type of machine.

By Mark Gilstrap

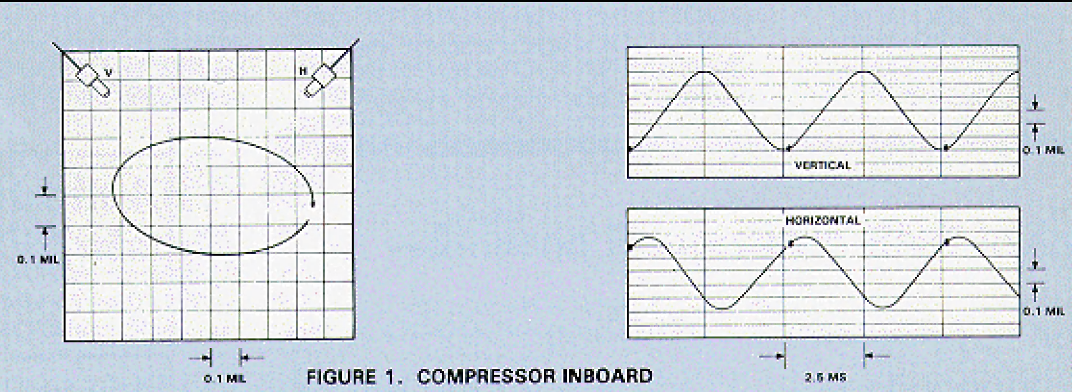

FIGURE 1. COMPRESSOR INBOARD

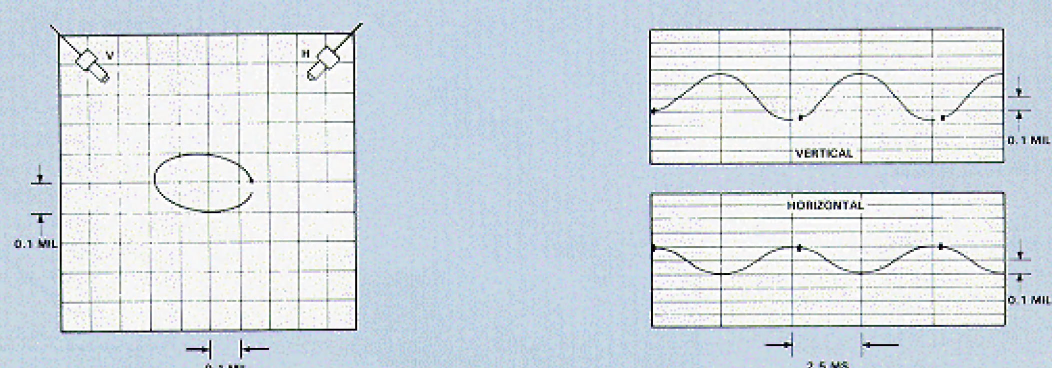

FIGURE 2. COMPRESSOR OUTBOARD